REMARKS

Claims 1-14 are currently pending in this application.

In the Office Action, the Examiner allowed claims 11-14 and indicated that claims 2-8 and 10 are also allowable if they are rewritten in independent form including all of the limitations of the base claim and any intervening claims. Applicant gratefully acknowledges the Examiner's indication of allowable subject matter.

The Examiner rejected claim 1 and 9 under 35 U.S.C. Section 102(e) as being anticipated by Hotomi (US Patent No. 6682170). Applicant respectfully traverses the rejection of claims which are being presented herein without any amendment.

The present invention relates to a color ink-jet printer in which a gray scale image is formed by selecting one of a plurality of different total volume values of at least one ink droplet to be ejected from each nozzle to form the corresponding ink dot at the corresponding picture element on a recording medium. More specifically, the printer defined in present claim 1 comprises:

a first ink ejecting portion operable to eject droplets of a first ink of a first color;

a second ink ejecting portion operable to eject droplets of a second ink of a second color other than the first color, the second ink being dried at a higher rate than the first ink;

a first control portion operable to control the first ink ejecting portion, on the basis of a gray scale value at a picture element of an image at which each dot of the first ink is to be formed on a recording medium, such that a total volume of at least one droplet of the first ink to form each dot on the recording medium is equal to anyone of a plurality of different total volume values; and

a second control portion operable to control the second ink ejecting portion, on the basis of a gray scale value at a picture element of an image at which each dot of the second ink is to be formed on a recording medium, such that a total volume of at least one droplet of the second ink to form each dot on the recording medium is equal to one of the plurality of different total volume values, which one is other than a smallest one of the different total volume values except a zero value.

Described more specifically, in the printer of claim 1, when the gray-scale value at the picture element at which a dot of the second ink having a drying rate higher than the first ink is to be formed corresponds to the smallest total volume value, the selection of the smallest total volume value to form the smallest dot of the second ink is inhibited, and any suitable

one of the larger total volume values is selected. The second ink whose drying rate is higher than the first ink is likely to suffer from an increase in its viscosity at the meniscus surface thereof at a given nozzle due to evaporation of an aqueous component of the ink at the meniscus surface, which takes place if the ejection of the ink droplets from that nozzle is absent for a relatively long time. In this case, the nozzle may undesirably suffer from plugging due to the increased viscosity of the ink. The color ink jet printer arranged as described above, however, effectively prevents the plugging of the nozzle of the second ink ejecting portion even after a long absence of ejection of droplets of the second ink.

Described in another way, the present invention according to claim 1 generally concerns a color ink-jet printer in which gray levels for each pixel is controlled by printing at one of a plurality of discrete total volume levels. In the embodiment shown in FIGS. 5A-D, there are four different total volume levels of ink: 1) "Large" volume (36 pl) as shown in FIG. 5A; 2) "Medium" volume (24 pl) as shown in FIG. 5B; 3) "Small" volume (12 pl) as shown in FIG. 5C; and "Very Small" volume (5 pl) as shown in FIG. 5D.

As described in the background section, the color yellow has a relatively high drying rate compared to the other colors such as magenta, black and cyan. Because of this, the meniscus surface of a nozzle may become highly viscous due to evaporation of the yellow ink. This high viscosity may cause "plugging" where the ink droplet fails to eject from the nozzle when printing at the "Very Small" total volume level.

According to the present invention, this problem is solved by a "second control portion" that prevents ejection of the "Very Small" total volume even when it is requested to do so. Instead, the second ink ejection portion selects "Small" total volume. That is, the second control portion selects the total volume of 12 pl ("Small" total volume) when requested to select the total volume of 5 pl ("Very Small" total volume). This feature provides an advantage of preventing ink ejection failure to provide a smooth and high quality image reproduction.

This novel feature is recited in claim 1 as "said second ink being **dried at a higher rate** than said first ink" and "a total volume of at least one droplet of said second ink ejected by said second ink ejecting portion to form said each dot of said second ink on the recording medium, is equal to **one of said plurality of different total volume values, which one is other than a smallest one of said different total volume values**".

Claim Rejections -35 USC § 102

Claims 1 and 9 are rejected under 35 U.S.C. 1O2(e) as being anticipated by U.S. Patent No 6,682,170 to Hotomi et al. Applicant respectfully traverses the rejections.

Cited reference to Hotomi et al.

In the Official Action, the Examiner alleges that the second ink having a higher drying rate than the first ink is "characterized by a second inks color having a permeability property different from said first ink color (column 53, claim 8)".

Claim 8 of Hotomi et al. recites a feature that ink in a second group is different in permeability to a recording sheet from ink in a first group which is complementary color ink to the ink in the second group. Embodiment 5-1 (column 32 through column 38) specifically describes this feature. In Embodiment 5-1, in addition to "normal color inks" including yellow ink (Y), magenta ink (M), cyan ink (C), and black ink (K), "complementary color inks" including blue ink, green ink, and red ink which are complementary colors to yellow, magenta, and cyan, respectively, are used to express secondary colors. The complementary color inks are higher in permeability into printing sheets than the normal color inks by addition of a penetrate thereto. (See line 65, column 34 , through line 25, column 35.) Hotomi et al. refers to a fact that although the inclusion of the penetrant is effective to increase the permeability of the ink into the printing sheets, the percentage of the penetrant to be included in an amount of exceeding 12.5 wt. % causes clogging of the print head, as described in lines 7-17 in column 36 and shown in the graph of Fig. 137.

Hotomi et al. discloses dot patterns as shown in Figs.139-143 which are used when the normal color inks and the complementary color inks described above are used in combination to form a desired image. In the dot patterns of Figs. 139-141, a single dot size is used for both of the normal color inks and the complementary color inks, namely, the normal color ink dots and the complementary color ink dots have the same diameter. In the dot patterns of Figs. 142 and 143, either one of the normal color ink dots and the complementary color ink dots is larger in diameter than the other of the normal color ink dots and the complementary color ink dots. Further, in each dot pattern of figs. 142-143, the dot size is common to all of the normal color ink and common to all of the complementary color ink dots.

Hotomi et al. does not give any indication that the total volume of the droplet for each of the complementary color ink and the normal color ink to be ejected is **selected from a plurality of different values**. Moreover, Hotomi et al. does not even remotely suggest that the total volume of the droplet of either one of the complementary color ink and the normal color ink is controlled such that a smallest one of different total volume values is inhibited **by taking into account a difference in the drying rate** between the complementary color ink and the normal color ink, in order to prevent the nozzles from being plugged. Accordingly,

the feature of claim 8 of Hotomi et al. is not relevant to the subject matter of claim 1 of the present application.

In the Official Action, the Examiner further alleges that "controller, col. 54, lines 4-9 (described in claim 13 of Hotomi) which controls dots to be formed in different tone levels expressed in term of dot size'" of Hotomi et al. teaches "the first control portion" and "the second control portion" according to the present invention. The controller recited in claim 13 of Hotomi et al. is arranged to control "said second group of print heads at a plurality of tone levels" and control "each print head of said first group of print heads to respectively print at only a single tone level".

The "controller" pointed out by the Examiner is specifically described in Embodiment 3-1 (column 22-column 27) and Embodiment 8-1 (column 47, column 52). In both of Embodiment 3-1 and Embodiment 8-1, there are used "normal color inks" including colors of yellow, magenta, cyan, and black and having normal tone and "photo color inks" for respective colors of yellow, magenta, cyan, and black which are lighter in tone or lower in concentration than the normal color inks and which are superior in reproduction of light colors and provides better reproduction of photograph images. The normal color inks and the photo color inks are used in combination for reproducing a smooth image with a larger number of tones.

In both of Embodiments 3-1 and 8-1, for image tone reproduction, there is employed a dot matrix with ink dots of different diameters which corresponds to a single pixel of an image to be printed, and the dot pattern in the dot matrix is changed in accordance with tone of the image.

More specifically described by referring to Figs 170-171 of Embodiment 8-1, each dot matrix corresponding to a single pixel that forms an image printed by an ink-jet printer is formed of two rows and two columns. As described in line 48, column 49, when image data corresponding to a single pixel has tone 14 shown in Fig. 170, for example, the tone 14 is represented by printing dot 601 of small diameter in normal color ink, dot 602 of intermediate diameter in normal color ink and dot 603 of large diameter in photo color ink. In the dot matrixes described in Embodiment 8-1, "a normal color ink dot is provided in multi-valued printing (i.e., any of dots having a plurality of diameters [small and intermediate in Figs. 170-171 and intermediate and large in Figs.173-174] is or is not printed) and a photo color ink dot is provided in binary printing (i.e., a dot [of single diameter, namely, large in Figs. 170-171 and intermediate in Figs. 173-174] is or is not printed)" as described in lines 21-33 in column 52.

In other words, in Embodiment 8-1, the size of the normal color ink dot is selected from a plurality of different diameters while the size of the photo color ink dot remains fixed

or the same throughout all of the dot matrixes. Namely, only large-diameter dot size is available for the photo color ink in dot matrixes of Figs. 170-171 while only intermediate diameter dot size is available for the photo color ink in dot matrixes of Figs. 173-174. **In Embodiment 8-1, Hotomi et al. does not give any indication that the total volume of the droplet of the photo color ink to be ejected is selected from a plurality of different values**. Moreover, Hotomi et al. does not even remotely suggest that the total volume of the droplet of the photo color ink is controlled such that a smallest one of different total volume values is inhibited by **taking into account a difference in the drying rate** between the normal color ink and the photo color ink, in order to prevent the nozzles from being plugged. Accordingly, the feature of the "controller" recited in claim 13 of Hotomi et al. Does not teach or suggest the subject matter of claim 1 of the present application.

In Embodiment 3-1 which describes dot matrixes shown in Figs. 95-96 and dot matrixes shown in Figs. 98-105, the size of the photo color ink dot is selected from a plurality of diameters, i.e., small, intermediate, and large, while the size of the normal color ink dot remains fixed or the same throughout all of the dot matrixes, in other words, only large diameter dot size is available for the normal color ink. Thus, in Embodiment 3-1, too, **Hotomi et al. does not teach that the total volume value of the droplet of the normal color ink is selected from a plurality of different values**. Furthermore, there is no suggestion in Hotomi et al. that the selection of a smallest one of different total volume values is inhibited for the normal color ink by **taking into account a difference in the drying rate** between the normal color ink and the photo color ink, in order to prevent the nozzle plugging.

In both of Embodiments 3-1 and 8-1, the normal color ink and the photo color ink are printed in respective different manners in terms of dot size as explained above, not from the standpoint of the drying rate of two types of ink as taught by the present invention, but from the standpoint of the concentration or tone. **There is no description in Hotomi et al. that the concentration or tone of ink is related to the drying rate.**

The Examiner, in rejecting present claim 1, unduly combines the features of different embodiments. According to the assertion of the Examiner, the two types of ink having mutually different permeability properties are printed in respective different manners in terms of dot size, namely, at multiple tone levels and a single tone level. There is, however, no reason to employ the printing manner applicable to the two types of ink having mutually different concentration or tone values, in printing by using the two types of ink having mutually different permeability properties. The features if combined do not arrive at the concept of claim 1 of the present application for the reasons described above.

Thus, Applicant submits that claim 1 of the present application is patentably distinguished over the cited reference to Hotomi et al., and the rejections are respectfully traversed.

Applicant submits that claim 9 by virtue of its dependency from claim 1 is patentable over the cited references.

Based upon the above amendments and remarks, Applicant respectfully requests reconsideration of this application and its earlier allowance. Should the Examiner feel that a telephone conference with Applicant's attorney would expedite the prosecution of this application, the Examiner is urged to contact him at the number indicated below.

Respectfully submitted,

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